Memorandum

To: Chris French

From: Pat Faessler

CC:

Date: March 22, 2004

Re: Biological Treatment of Waukegan PCB Sediments-Response to comments

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EPA review of BSI documents resulted in some comments concerning the success of technology.

Summary

Comments:
There is skepticism regarding the BSI Bioremediation Technology on PCB's;
The technical approach of BSI does not indicate the successful biological treatment of PCB's;
There is concern regarding the Laboratory Testing Methodology;
The literature clearly indicates that there is not significant reduction in PCB concentration or toxicity when PCB concentrations are the low range found in Waukegan Harbor sediment.

Response: The task of biologically degrading PCB's is a difficult task. Due to the difficulty of this task we are not surprised to encounter some skepticism. Published research repeatedly indicates that efficient microbial degradation of PCBs requires diverse metabolic activities due to the high number of congeners. In addition, degradation of PCB's has been shown to occur primarily via co-metabolism in that the microorganisms responsible for PCB transformation are unable to grow on PCBs as a sole carbon source and require a co-substrate for microbial growth and degradation activity. Composting is an ideal way to provide both a highly diverse microbial community with a range of metabolic capabilities and co-substrates for PCB metabolism. Review of technical literature finds other published reports of successful composting of PCB's. Reported Degradation of PCB's ranged for 15-74%. Published literature also indicates the higher the PCB concentration the faster the rate of degradation. One published report identifies a pilot project in Michigan in which Aroclor 1248 concentrations were reduced by 45%.

Volatilization

Comments:
The researchers state that volatilization is unlikely at 30 degrees C and therefore no air testing was needed;
Extensive literature clearly indicates that PCB's are known to volatilize at ambient temperatures;
PCB's can and do volatilize from sediments at ambient temperatures in substantial amounts.

Response:
BSI did not perform any monitoring to measure Volatilization during the composting study. However, other researchers have. Elevated temperatures generated during composting and convection of air

through compost piles could potentially increase the extent of PCB volatilization from contaminated soils. Published research (Hogan et al, 1989) indicated that 1.6% of a low chlorinated Aroclor mixture (Aroclor 1232) was volatilized after 35 days of composting at 50 degrees C. However, the extent of volatilization of higher chlorinated mixtures such as Aroclor 1248, 1254 and 1260 from composts had not been determined until 1999 by Michel et al. Michel et al measured the volatilization of Aroclor 1248 in a fixed reactor at 55 C for 50 days with forced aeration. Results indicated that less than 1% of the PCB's present in the soil was volatilized.

The research presented by Michel measured volatilization on like chlorinated PCB's (Aroclor 1248) under composting conditions more conducive to volatilization, 55 degrees C and forced aeration as opposed to BSI at 30-35 degrees C and static piles, and found less than 1% loss to volatilization.

Based on the degree of chlorination of the PCB's and volatilization studies performed by other PCB compost researchers BSI is confident the loss of PCB's through volatilization is less than 1%

Experimental Conditions

Comments.
Experimental conditions were not similar to treatments versus the control;
The biological experiments were conducted at temperatures up to 34.6 degrees C, while the controls were kept at 20.4, which is at least a 10-degree difference;
The rate of volatilization significantly increases with a 10-degree C increase in temperature;
There was a 70% reduction in PCB's in the experiment controls by addition of compost

Response: Experimental conditions were identical in the treatment and control tests with the exception that organic material was added to the test reactors and not the control reactors. The purpose of the tests was to determine if degradation occurred through composting. Reactors were left at room temperature. The increase in temperature observed in the test reactors was due to biological activity and not any outside source. The control reactor lacks the biological activity to produce measurable temperature increase. However, concerns about an increase in volatilization should be minimal based on the above referenced volatilization studies indicating less than 1% volatilization of Aroclor 1248 in 55 degree C compost over a fifty day period.

The reviewer has focused on the reduction in concentration attributed to the addition of compost amendments and overlooked the reduction in concentration after the addition of amendments. After the addition of compost amendments test A has a PCB concentration of 1933 µg/kg and test B a PCB concentration of 1200 µg/kg. Concentrations then decreased to 560µg/kg in test A and 710 µg/kg in test B, with test B taking more time.

It is very important to understand what happens in the composting process. During the composting process the organics are rapidly degraded with 40 to 70% of the organic matter in compost converted into carbon dioxide and water and the rest converted into humic fractions. The majority of this degradation occurs within the first 4-6 weeks. If the contaminants are not degrading or are degrading more slowly than the compost organics, the concentration of the contaminant goes up. This is a common occurrence when composting herbicides and was also observed by at least one published PCB Composter. Lazarri et al observed a 53 to 73 ppb increase in PCB concentration (dry weight basis) after 90 days composting. This actually represented a 9-15% decrease in PCB concentration due to a 38% overall loss in dry matter.

Dilution

Comments:

The authors have shown that the more you heat the PCB-impacted sediments and the more you will dilute them, less PCB's will result;
The methodology for the control batch and the treatment batches should have been identical.

Response:

An initial reduction in starting concentration is observed when compost amendments are added to contaminated soils. These compost amendments (40-70% depending on type) are rapidly degraded into carbon dioxide and water. This loss of organic matter greatly reduces the effect of any initial "dilution". Concentration of the PCB contaminants continues to decrease over time after the addition of compost amendments.

Cost

Comments:
If the air stripping/dilution process would work, the cost of safely handling the sediment and treating it in mixed vats would be higher than transporting it to a landfill for disposal;
BSI provided an incomplete cost estimate regarding the receiving and transport of sediments.

Response:

Composting technology is cost competitive to landfill technology. BSI's cost estimate was not incomplete. Complete treatment costs were provided as well as costs for transportation of sediments within a nominal range. If sediments required additional transportation an additional cost would be incurred.

Other Points of Interest

EPA region V accepts composting as a viable remediation technology. For example, composting is currently being implemented on multiple explosives contaminated soils within the EPA Region V.